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Cognitive Bias and Unusual Experiences in Childhood

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Abstract: 216 words

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Abstract (216 words):

Background: Cognitive therapy is recommended for children with psychotic-like, or unusual, experiences associated with distress or impairment (UEDs; UK National Institute for Health and Care Excellence, 2013 [1]). Accurate models of the psychological underpinnings of childhood UEDs are required to effectively target therapies. Cognitive biases, such as the Jumping to Conclusions data-gathering bias (JTC) are implicated in the development and maintenance of psychosis in adults. In this study, we aimed to establish the suitability for children of a task developed to assess JTC in adults.

Method: Eighty-six participants (aged 5-14 years), were recruited from Child and Adolescent Mental Health Service (CAMHS) and community (school) settings, and completed the probabilistic reasoning ('Beads') task, alongside measures of intellectual functioning, general psychopathology, and UEDs. Self-reported reasoning strategy was coded as 'probabilistic' or 'other'.

Results: Younger children (5-10 years) were more likely than older children (11-14 years) to JTC (OR=2.7, 95%CI=1.1-6.5, $p=0.03$); and to use non-probabilistic reasoning strategies (OR=9.4, 95%CI=1.7-48.8, $p=0.008$). Both UED presence (OR=5.1, 95%CI=1.2-21.9, $p=0.03$) and lower IQ (OR=0.9, 95%CI=0.9-1.0, $p=0.02$) were significantly and independently associated with JTC, irrespective of age and task comprehension.

Conclusions: Findings replicate research in adults, indicating that the 'Beads' task can be reliably employed in children to assess cognitive biases. Psychological treatments for children with distressing unusual experiences might usefully incorporate reasoning interventions.

Key words: psychotic-like experiences, PLEs, reasoning, jumping to conclusions, JTC, cognitive therapy

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1. Introduction

Unusual, or 'psychotic-like', experiences, such as hearing voices, seeing things that other people cannot, believing that someone is watching you or following you, or having thoughts that may appear odd to others, are common in the general population [2, 3] with a peak prevalence in mid-childhood [4, 5]. They are usually transient and resolve of their own accord, but a significant minority (around 15%) of the general population report unusual experiences associated with distress or impairment (UEDs; [6-9]). Rates are greater among young people presenting to Community Child and Adolescent Mental Health Services (CAMHS), with a higher proportion of distressing UEDs reported, irrespective of presenting problem [10, 11]. Longitudinal studies have associated persistent and impairing childhood UEDs with trajectories towards the development of at-risk mental states and transition to clinical psychosis (e.g. [12]). The UK National Institute for Health and Care Excellence recommends offering psychological interventions to children with UEDs [1], aiming to reduce current distress, increase resilience, and improve future mental health outcomes. It is important, therefore, to identify the psychological mechanisms involved in the development and maintenance of UEDs, as these will be the targets for an effective therapy.

Cognitive models of psychosis in adults propose that psychosis occurs as the result of an interaction of multiple, heterogeneous risk factors, including biological predisposition, adverse life events, emotional disorders, and unusual experiences. Core cognitive, affective, social and behavioural mechanisms act as maintaining factors and are addressed by cognitive-behavioural interventions (e.g. [13]). Central to the development of psychosis is the appraisal of experiences (both actual events and perceptual anomalies) as external, personal and threatening. Cognitive and affective reasoning biases influence the appraisal process and thus make a significant contribution to the development and maintenance of psychosis [14].

Amongst these reasoning biases, the Jumping to Conclusions (JTC) data-gathering bias is the most consistent in its association with psychosis [15, 16]. The JTC bias comprises a tendency to the early termination of data-gathering and acceptance of ideas, which is hypothesised to lead to false conclusions, and the development of delusions [14,17]. Depending on the method of measurement, the bias is observed in 30-60% of adults with delusions (compared to 10-20% of the general population), and is present from first episode as well as being associated with an at-risk mental state and non-clinical unusual experiences, including delusion proneness [14, 18-26]. Most importantly, the JTC bias appears to be modifiable, at least in part, through brief, targeted interventions, with most studies reporting consequent reductions in symptomatology [27-34]. It therefore has potential as a treatment target which could reduce vulnerability to the later development of psychosis, as well as reducing concurrent symptom severity.

Emerging evidence suggests that the psychological vulnerability and maintenance factors implicated in adult cognitive models of psychosis are also associated with childhood unusual experiences [35,36]. A recent study by our group has shown that the tendency to JTC, along with affective processes, and adverse life events, is significantly and independently associated with the severity of unusual experiences (overall conviction, frequency, distress and adverse impact) in young people aged 8-14 years presenting to mental health services [10]. However, while affective processes and life events are commonly and routinely assessed in young people's services using age-appropriate standardised instruments, the reasoning biases associated with psychosis have not been systematically investigated in a child and adolescent population.

Extrapolating findings from the literature on reasoning biases in adults may be premature as cognitive skills, and particularly reasoning skills, continue to develop through to adolescence [37]. Studies suggest that children under 11 years grasp the concept of probability, but may

be confused by task complexity and presentation (e.g. [38, 39]). Although both task comprehension and intelligence can influence the tendency to JTC in adults [40,41], neither factor has been conclusively demonstrated to reduce the association of the bias with psychosis. It remains unknown, therefore, whether changes in cognitive profile occurring during childhood render standard adult assessments of probabilistic reasoning unsuitable, or whether they may still be used to investigate the role of cognitive biases in childhood UEDs and to reliably identify young people for whom reasoning interventions could be helpful.

The current study was designed to address this question. We employed a probabilistic reasoning task that had been standardised with adults, and demonstrated to elicit the JTC bias. Our primary aim was to ascertain the suitability of the task as an assessment of the JTC bias in children recruited across community and CAMHS settings. We focused firstly on the influence of age and comprehension on task performance, and any variation in this between settings. We then considered how the associations that have been demonstrated in adults, of JTC with UEDs and with IQ, were affected by age and task comprehension.

Our specific hypotheses were:

1. The tendency to JTC will be associated with age, such that rates of the bias will be increased in younger children, irrespective of setting, and this will be mediated by poor task comprehension; and
2. The JTC bias will be associated with UEDs and IQ, replicating findings in adults, irrespective of age and task comprehension.

2. Method

2.1. Participants

Clinically-referred participants were recruited during the first 15 months of a larger study (ISRCTN:13766770) from the waiting list of a South London Child and Adolescent Mental Health Service (CAMHS) offering brief assessment and intervention for young people with emotional and behavioural problems, which did not usually meet diagnostic criteria for a specific mental illness. The sample overlaps with that reported in [10].

Community participants were recruited from a school in the same geographic area; their caregivers were asked to confirm the absence of any mental health history.

Children were aged between 5 and 14 years. All participating children completing a JTC task were included in the current study.

2.2. Measures

2.2.1. Demographic data (age, gender, and ethnicity) were collected from the child's primary caregiver. Based on the literature on cognitive development, children were grouped by age into those of primary school age (5-10 years), and those of young secondary school age (11-14 years). Self-reported ethnicity was coded dichotomously (BME: any black or minority ethnic group; non-BME: white British or Irish). IQ was estimated (CAMHS participants only) using the British Picture Vocabulary Scale (BPVS), which measures receptive vocabulary and correlates highly with verbal ability [42]. As age was a focus of the study, we used raw, unstandardised BPVS scores.

2.2.2. The Jumping to Conclusions data-gathering bias ('Beads' game [43])

We employed two computerised variants of the Garety and colleagues version of this probabilistic reasoning task [30] (renamed the 'Beads Game' for this study): the first comprising two jars of 100 orange and black beads in 85:15 and 15:85 ratios, respectively; and the second with green and purple beads in 60:40/40:60 ratios. Instructions were slightly

modified to be suitable for a younger age group, and were approved by the author of the task (Figure 1). Participants were presented with the two jars and told that they would be shown a series of beads, drawn one at a time, from one of the jars. The jar would be chosen at random, and shaken to mix the beads. Their task was to decide from which jar the beads were being drawn. The bead sequence was in fact predetermined for both the 85:15 (OOOBOOOBOOOBOOOOOO) and 60:40 (PGGPPGPPPGPPPPGPPGPPG) versions. Participants could indicate their decision at any point in the series of bead draws, up to the 20th draw, after which a decision was requested. Each screen included a reminder of previously shown beads, and the on-screen presentation was supplemented by a physical demonstration of the jars being shaken at the start of the task. . Number of draws (beads) to decision, and jar choice were recorded. A dichotomous outcome variable (JTC/no JTC) was derived whereby participants who made at least one decision based on two or fewer beads were considered to show the JTC bias [43, 44]

Comprehension of the probabilistic nature of the task was assessed after participants had completed both the 85:15 and 60:40 variants by asking: ‘Could you please explain to us why you picked that jar?’ Responses were recorded verbatim by the researcher. A coding frame for the explanations was developed by three of the authors (NH, TR, SJ) comprising five categories: probability, recency/salience, hunch, suspicious thinking, and concrete/other (Table 1). Inter-rater reliability for the three original raters was excellent (intraclass correlations, $r=0.94$ for the 85:15 task; $r=0.95$ for the 60:40 task) and was improved by the addition of three further independent raters (intraclass correlations, $r=0.97$ for the 85:15 task; $r=0.97$ for the 60:40 task). Categories were collapsed for analysis into a dichotomous rating of ‘probabilistic’ (either or both explanations based on probability) or ‘other’. As the first 18

CAMHS participants completed assessments prior to the addition of this question, their task comprehension was coded as ‘unrated’.

Table 1 about here

2.2.3. Unusual Experiences [45, 5]

This nine-item, self-report questionnaire, administered to the CAMHS group only, assessed a range of unusual experiences, including five items adapted from the Diagnostic Interview Schedule for Children [46]. Items were rated for conviction: 0 (not true); 1 (somewhat true); 2 (certainly true). Endorsed items were rated for associated Distress (‘How much does this upset you?’) and Impact (‘How much does it make things hard at home or school?’): 0 (not at all), 1 (only a little), 2 (quite a lot), 3 (a great deal). Participants scoring above zero on either Distress or Impact formed the ‘UED’ group; the remaining participants were classified as the ‘no-UED’ group.

2.2.4. Strengths and Difficulties Questionnaire (SDQ [47])

This self-report questionnaire comprising five subscales, of five items each, measured emotional symptoms, conduct problems, hyperactivity-inattention, peer relationship problems, and pro-social behaviours over the past six months. The first four psychopathology scales were summed to derive a ‘total difficulties’ score (range 0-40).

2.3. Procedure

Approvals for the study were obtained from the Hampstead Research Ethics Committee (ref. 11/LO/0023), London Metropolitan University (project ref. 10000027), the local CAMHS service, and the school. A member of the research team contacted families on the CAMHS

waiting list; study information packs were mailed to parents/carers who then provided written informed consent. Subsequently children provided written assent. The measures for this study were completed as part of a larger battery of assessments. For the school sample, parents returned consent forms by post. For both samples, children completed the measures with assistance as required from a trained researcher.

2.4. Statistical analysis

Analyses were conducted using SPSS 20 (IBM, 2011). Age group (<11/≥11 years), gender, JTC, task comprehension (probabilistic/other), and SDQ total difficulties score differences by setting (CAMHS/community) were assessed using Chi-squared and t-tests, as were associations of the JTC bias (JTC/no JTC) and task comprehension with clinical and demographic variables (including ethnicity [BME/non-BME]) and IQ for the CAMHS group). Task comprehension analyses included the ‘unrated’ category, using a one-way three-level (probabilistic/other/unrated) ANOVA, within the CAMHS group only (as all ‘unrated’ participants were from the CAMHS group).

We employed a series of binary logistic regressions with JTC as the dependent variable to test each hypothesis. The first series, testing hypothesis 1, included all participants, and comprised four separate regression analyses. Firstly, age group was entered as an independent variable alone (Regression 1.1), then controlling for setting (community/CAMHS; Regression 1.2). Next, task comprehension was entered alone, with probabilistic reasoning as the reference category (Regression 1.3), then controlling for setting (Regression 1.4). Finally, age group and task comprehension were entered simultaneously (Regression 1.5) and

finally, age group and task comprehension were entered simultaneously, controlling for setting (Regression 1.6).

The second series, testing hypothesis 2, included only CAMHS participants, and also comprised four separate regression analyses. Firstly, UED group (UED/no UED) was entered as an independent variable alone (Regression 2.1). UED group was then entered controlling for task comprehension and age group (Regression 2.2). In the third regression IQ was entered controlling for age group (Regression 2.3), then for age group and task comprehension (Regression 2.4); and finally both UED group and IQ were entered, controlling firstly for age group (Regression 2.5) and then for age group and task comprehension (Regression 2.6). A final backward regression (Regression 2.7) with JTC as the dependent variable and task comprehension, age group, IQ and UED group entered together as predictors, identified the primary correlates of the JTC bias.

3. Results

3.1. Demographic characteristics and task performance

Table 2 about here

A total of 86 young people participated in the study, 41 from a community setting and 45 from CAMHS. The settings did not differ in their distribution of age group, gender, JTC or task comprehension (Table 2), but community participants, as would be expected, tended to have fewer difficulties on the SDQ (11.4 (SD=5.9)) compared to 14.8 (SD=6.3), $t=2.5$, $df=83$, $p=0.01$), and, although age group was evenly distributed, also tended to be younger

(community mean 8.1 years (SD=2.5), CAMHS mean 10.7 years (SD=1.8), $t=5.5$, $df=72.7$, $p<0.001$). Just under half of participants jumped to conclusions (40/86, 46%), and the majority of young people who were asked to explain their response comprehended the task and employed probabilistic reasoning (54/68, 79%). Neither the tendency to JTC nor task comprehension varied with gender, ethnicity (56% of CAMHS participants were from BME backgrounds) or SDQ total scores (χ^2 values < 1.0 ; t values < 1.5 ; $F < 0.25$; p values ≥ 0.1). JTC was associated with IQ (JTC mean IQ: 89.2, SD 17.5; no JTC mean IQ: 103.2, SD 13.3, $t=3.0$, $df=43$, $p=0.004$; $d=0.8$, large effect size, ES [48]), but task comprehension was not (probabilistic: mean IQ = 100.3, SD 17.1; non-probabilistic: mean IQ = 91.2, SD 23.5; unrated: mean IQ = 92.4, SD 14.7, $F(2,42)=1.3$, $p=0.3$). Both the tendency to JTC ($\chi^2=5.0$, $df=1$, $p=0.03$; Cramer's $V=0.2$, small to medium ES) and lack of task comprehension ($\chi^2=6.4$, $df=1$, $p=0.02$; Cramer's $V=0.3$, medium ES) were more common in the younger age group (Table 3), and both the JTC group and the non-probabilistic reasoning group tended to be younger (JTC mean 8.9 years (SD=2.7), no JTC mean 9.9 years (SD=2.3), $t=-2.0$, $df=84$, $p=0.05$; probabilistic mean 9.6 years (SD=2.5), other mean 7.3 years (SD=2.2), $t=3.1$, $df=66$, $p=0.003$). The probabilistic reasoning group were less likely to JTC (35%) than the non-probabilistic group (85%; $\chi^2=11.4$, $df=1$, $p=0.001$; Cramer's $V=0.4$, medium to large ES). The unrated group fell in between (50% JTC).

Table 3 about here

Hypothesis 1: The JTC bias will be associated with age, such that rates will be increased in younger children, irrespective of setting, and this will be mediated by poor task comprehension.

Binary logistic regression (Table 4) demonstrated that younger children (5-10 years) were almost three times more likely to JTC than not compared to older children (11-14 years; odds ratio, OR=2.7, 95% confidence interval (CI); 1.1-6.5; small to medium effect size (ES [49]; Regression 1.1). The OR was similar, irrespective of controlling for setting (Regression 1.2, Table 4). The use of non-probabilistic reasoning strategies also increased the odds of jumping to conclusions (OR=11.0, 95% CI 2.2-54.6, $p=0.003$; large ES; Regression 1.3), again, irrespective of setting (Regression 1.4, Table 4). Controlling for the effects of age, children who employed a non-probabilistic strategy were almost nine times more likely to JTC than not compared to those reasoning probabilistically (OR=8.7, 95% CI =1.7 to 44.3, $p=0.009$; large ES, Regression 1.5). The association of age with JTC was reduced, and rendered non-significant (OR=2.0, 95% CI 0.8-5.1, $p=0.1$; Regression 1.5), by the addition of task comprehension as an independent variable, suggesting partial mediation. The pattern remained the same irrespective of controlling for setting (Regression 1.6; Table 4).

Hypothesis 2: The JTC bias will be associated with UEDs and IQ irrespective of age and task comprehension

The JTC bias was associated with UEDs, such that the UED group were five times more likely to JTC than not compared to the no UED group (OR=4.9, 95% CI 1.3-19.1, $p=0.02$; medium ES; Regression 2.1). The association of JTC with UEDs was independent of the association with age group alone (Regression 2.2, Table 4) and age group plus task comprehension, and the odds ratio (OR) was not reduced by controlling for these variables (Regression 2.3, Table 4). The JTC bias was also associated with IQ, independently of age group (Regression 2.4, Table 4) and age group plus task comprehension, such that the odds of showing the bias reduced as IQ increased (OR=0.9; small ES; Regression 2.5, Table 4).

Controlling for IQ, age group and task comprehension slightly reduced the association of JTC

with UEDs (Regression 2.6, Table 4), but both remained the sole significant predictors of JTC, with similar effect sizes in the final backward regression model (Regression 2.7, Table 4).

Table 4 about here

4. Discussion

We aimed to investigate the suitability of the standardised ‘Beads’ task [30], which is an established measure of the tendency to JTC in adults, as an assessment of the same tendency in children and adolescents.

It was hypothesised that task performance would be associated with development such that younger children aged under 11 years would show higher rates of JTC, and that this would be mediated by poorer comprehension of the task. The hypothesis was supported in this combined group of children recruited from the community and from CAMHS.

Additionally, it was hypothesised that the JTC bias would be specifically associated with UEDs and IQ, measured only in the CAMHS setting, irrespective of age and task comprehension. This hypothesis was also supported.

Rates of JTC were elevated in child participants compared to adults in the general population [14, 18-20], and the likelihood of JTC reduced with age. Children under 11 years were more likely to JTC (57%), while only a third (33%) of older children (≥ 11 years) demonstrated the bias. Comprehension of the probabilistic nature of the task developed with age, as older children were less likely to provide non-probabilistic explanations of their performance.

Results were consistent with a mediating role for task comprehension in the association of JTC with age. Irrespective of these factors, the JTC bias remained associated with UEDs. As in adult literature, both lower IQ and UEDs in the CAMHS setting significantly and

independently increased the odds of JTC. These associations were consistent, irrespective of controlling for age and task comprehension.

The findings suggest that the probabilistic reasoning tasks employed to assess the JTC bias in adults with psychosis are also suitable for children, and could be employed to test for the presence of the bias in order to target psychological therapies.

Some limitations of design should be noted. Firstly, the sample size was relatively small, and reduced ($n=45$) for hypothesis two, as IQ and UED data were only collected for the CAMHS group. Secondly, we did not employ a case control design; and although the CAMHS and community groups did not significantly differ in their age group and gender distribution, they were not specifically matched for these variables. Community participants were younger, and although setting was not associated with either JTC or task comprehension, and controlling for setting did not change the pattern of results, it would have been preferable to avoid this confound. Age was categorised crudely into primary and secondary school age, and a larger study would permit a finer grained analysis of development stage. Thirdly, there is inconsistent evidence that JTC is associated with particular psychotic symptoms (e.g. [50, 51]). In this study, all UEDs were considered together, as they have been demonstrated to form a unitary construct [5]. Future research should address the relationship between JTC and the form of childhood UED.

The results suggest that our earlier findings of an association of JTC with childhood unusual experiences are as reliable as similar associations reported in adults, and are still valid in CAMHS settings, despite the influence of cognitive changes occurring during childhood. The relationship demonstrated here between UEDs and the JTC is highly relevant to the

design of interventions for young people with UEDs and at risk of developing psychosis, and suggests a focus on increasing information gathering, alongside normalising, psychosocial and psychoeducational cognitive interventions. Longitudinal studies are needed to explore the causal relationship between UEDs and the JTC bias, alongside other cognitive, emotional and social factors, and to establish the protective effects that might be gained from early psychological interventions.

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Conflict of Interest:

There were no conflicts of interest.

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Figure 1: Beads game instructions for children

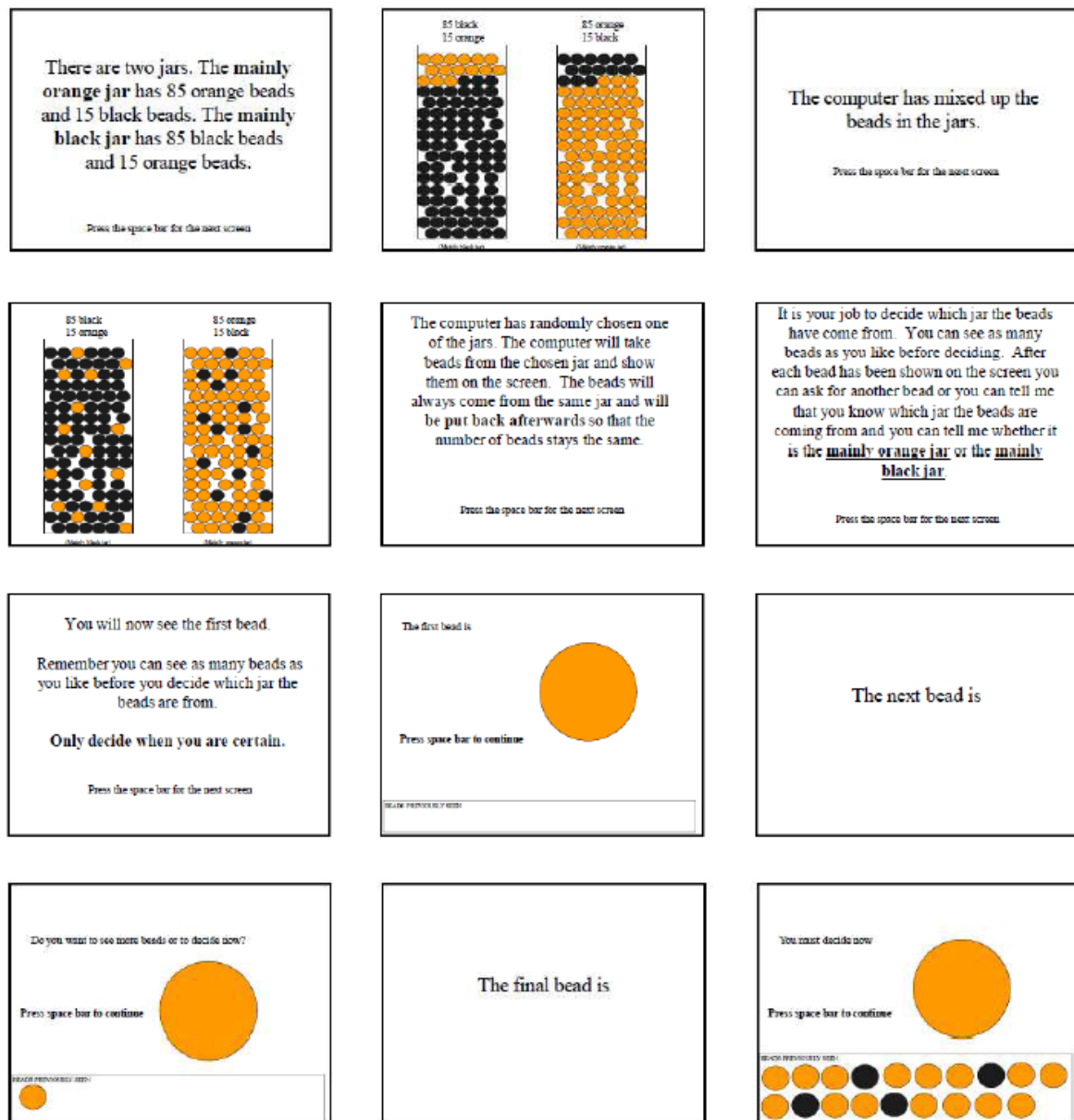


Table 1: Explanations for reasoning task performance

Category	Definition
Probability	The participant demonstrates logical thinking, references to the quantity of coloured beads and making a weighted decision based on the beads they have been shown; e.g. ‘There have been more orange beads than black beads.’
Recency & Saliency	Explanations that are based on the last bead the participant can recall, or on the particular importance of a specific bead; e.g. ‘Because the last bead it took out was a black bead.’
Hunch	Explanation based on intuition, instinct or guess; e.g. ‘I guessed it.’
Suspicious Thinking	Not trusting the task or the researcher; seeing ulterior meaning in the beads shown; e.g. ‘The computer wants to trick you.’
Concrete/ Other	Explanation shows a failure to appreciate the probabilistic, data-gathering nature of the task, relying instead on the visual presentation of the beads not drawn, or some other concrete aspect of the task; e.g. ‘Saw the pattern on the 1st line and bottom line and the beads that came out looked like the pattern from the purple jar’.

Table 2: Demographic characteristics and task performance by setting (n=86)

Variable	Setting		Test
	CAMHS n=45	Community n=41	
Frequency			
Age group (<11/≥11 years)	22/23	25/16	$\chi^2=1.2$ (df=1), p=0.3
Gender (Male/Female)	30/15	23/18	$\chi^2=1.0$ (df=1), p=0.4
JTC/no JTC	22/23	18/23	$\chi^2=0.2$ (df=1), p=0.7
Task comprehension (probabilistic/other)	23/4 ^a	31/10	$\chi^2=0.9$ (df=1), p=0.4

Key: CAMHS: Child and Adolescent Mental Health Services; JTC=Jumping to Conclusions bias; ^an=18 CAMHS participants did not complete this, so were 'unrated'.

Table 3: Rates of Jumping to Conclusions (JTC) by task comprehension and age group (n=86)

Age group	Task Comprehension	n	%	JTC Either task		JTC 85:15 task		JTC 60:40 task	
				n	%	n	%	n	%
5-10 years	Probabilistic	26	55%	12	57%	10	38%	5	19%
	Other	12	25%	10	83%	9	75%	7	58%
	Unrated	9	19%	5	46%	4	44%	2	22%
	Total	47		27	56%	23	49%	14	30%
11-14 years	Probabilistic	28	72%	7	25%	5	18%	1	17%
	Other	2	5%	2	100%	2	100%	1	50%
	Unrated	9	23%	4	44%	4	44%	2	22%
	Total	39		13	33%	11	28%	4	10%
All	Probabilistic	54	63%	19	35%	15	28%	7	13%
	Other	14	16%	12	86%	11	79%	9	64%
	Unrated	18	21%	9	50%	8	44%	4	22%
	Total	86		40	46%	34	39%	20	23%

Table 4: Binary logistic regression analyses illustrating the association of the tendency to jump to conclusions (JTC) with age group, task comprehension, IQ and UEDs.

Regression	Independent variable(s)	OR	95% Confidence Interval OR	p
1.2	Age group	2.7	1.1 – 6.5	0.03
1.4	Task comprehension (x2)	12.0	2.4-60.7	0.003
1.6	Age group	2.3	0.8-7.0	0.1
	Task comprehension (x2)	9.4	1.7-48.8	0.008
2.2	UED	5.4	1.3-22.4	0.02
2.3	UED	5.1	1.2-21.9	0.03
2.4	IQ	0.9	0.9-1.0	0.02
2.5	IQ	0.9	0.9-1.0	0.02
2.6	UED	4.2	0.9-19.4	0.07
	IQ	0.9	0.9-1.0	0.04
2.7	UED	4.1	1.0-17.5	0.05
	IQ	0.9	0.9-1.0	0.02

Key: OR=Odds ratio; UED: Unusual Experiences associated with Distress; IQ: Intelligence Quotient; Regressions: .1.2, 1.4, 1.6: controlling for setting ; 2.2, 2.4: controlling for age group; 2.3, 2.5, 2.6: controlling for age group & task comprehension (x3); 2.7 controlling for age group & task comprehension (x3), backwards model, final step.